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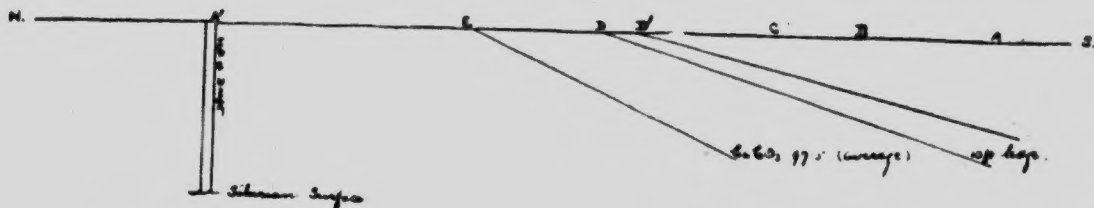
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THE GEOLOGICAL CONTINUITY OF ESSEX AND KENT COUNTIES, ONTARIO, AND MONROE AND WAYNE COUNTIES, MICHIGAN.

REV. THOMAS NATTRESS.

When requested by the secretary of the Geological Department of the Academy, and at the instigation of the State Geologist of Michigan, to prepare a paper to be read here, I recognized in the request a challenge to solve a problem. That problem is to explain the presence, elevation, dip, and nature of the outcrop of the Corniferous (*or Dundee) in the Amherstburg Quarries, in Anderdon Township, Essex county, Ontario. According to the ascertained lines of outcrop of Silurian strata on the Michigan side of Detroit river at its mouth, the same Silurian surface extension would be looked for in the Southern half of Essex. But it isn't there—except in the river bed, and northward of Lime Kiln Crossing ashore. In its place is an outcrop of Corniferous, with southwesterly dip at the Amherstburg Quarries, and maximum elevation of 609 feet. The successive lines of outcrop in Ontario and Michigan, concentric in the coal area of Michigan, would lead one to expect a north to northwesterly dip. But the natural expectation is denied by the contrary fact.

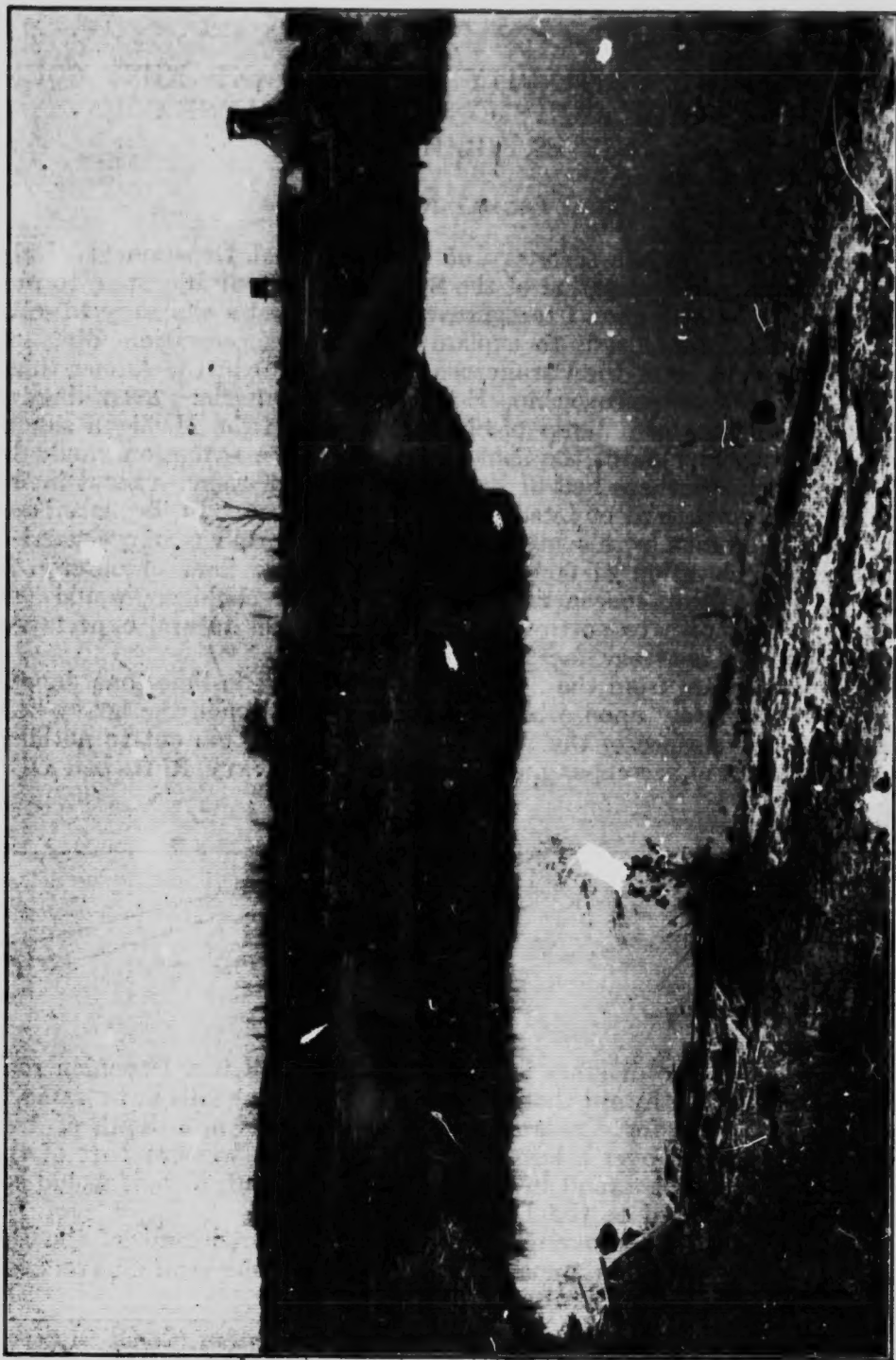
The several strata, from the bottom of the high grade limestone deposit which lies immediately upon a brown dolomite, up through the heavy-bedded rock, to the surface of the thin-bedded limestone, thin out to nothing, as illustrated in the accompanying diagram by the heavy 10 ft. bed DD¹.



From A to B in the diagram is drift. From B to E is a Devonian rock surface. From E northward the rock (which is Silurian) falls away rapidly, until at A', less than forty rods away, it is 50 feet down, a depth of drift that is fairly uniform over a large area of the middle western part of the county. There may be a fault in the Silurian here. But, if so, it would explain nothing in regard to the Devonian outcrop.

The evidence goes to prove a Silurian anticlinal, northward of the Devonian deposit in Anderdon, upon which the Corniferous strata have been deposited with south to southwesterly dip.

* The Dundee of Monroe county, as described by Professor Sherzer (Geological Report on Monroe County, Vol. VII, p. 1, Geological Survey of Michigan, 1900), is essentially a high grade limestone; whereas, in the Amherstburg quarries there are three several deposits, the lower averaging 97.5 Ca Co₃, the middle about 60.9, and the upper 80.+ (See Bureau of Mines Ontario, 1904, Vol. II, "The Limestones of Ontario.")



High grade limestone quarry at the Amherstburg Quarries, in spring-time, showing dip of strata. Essex County.



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Were there sufficient exposure of the rock surface to facilitate observation, the dip of the overlying formation would doubtless be seen to circle round the anticlinal as this falls away eastward, until the north to north-westerly dip would be found again on the north side of the anticline, the same dip as on the opposite side of Detroit river.

Let it be noted that there is a Silurian surface extension immediately northward of the Amherstburg Quarries. The log of the Sucker Creek Oil and Gas Company's test well, lot 7, con. 6, in Anderdon Township (some six miles northeast from the point A' in the diagram), shows dolomite from the surface down, 350 feet of it over the Sylvania.

The Rock Surface of Essex County falls away eastward from an elevation of 609 feet at the quarries in Anderdon, to 533 feet at Essex town near the center of the county. There is a further fall to 476 feet at Comber, and to something less than this at the Kent county line. (This is a medial line, both territorially and with reference to surface drainage.) From the same starting point of 609 feet elevation, eastward through the southern part of the county, there is the same falling away, but less pronounced. At Marshfield, southeast from the highest point of rock elevation in the county, at the Amherstburg Quarries, and southwest from Essex town, the rock elevation is 521 feet. At Leamington, southeast of Essex town and south of Comber, it is 502 feet; and at the county line less than 500 feet. In the northern part of the county the elevation of the rock surface is 492 feet at Belle River; and there is evidence that it is lowest at the northeast corner of the county, at the mouth of the Thames river.

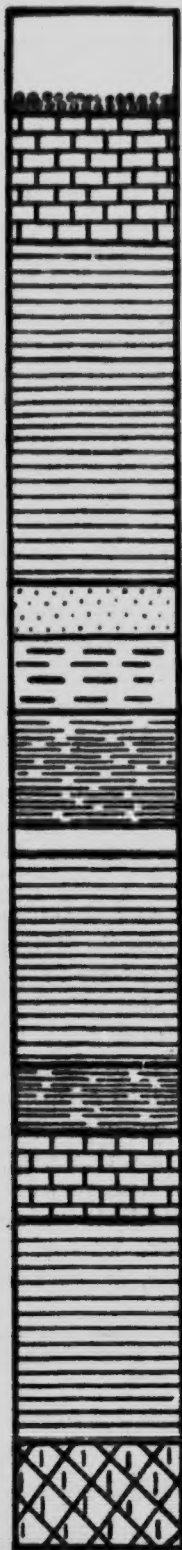
Were the analyses forthcoming they would, therefore, doubtless show, not only that the Corniferous extends into Essex county along the ascertained lines of outcrop in Monroe and Wayne counties, overlain northward by the Hamilton and Genesee, in order; but also that it circles round as above suggested to where it has the southward dip as exposed in the Amherstburg Quarries.

I make the statement on the authority of Mr. Eugene Coste, late mining engineer of the Geological Survey of Canada, who has done a great deal of exploring for gas and oil in both Essex and Kent counties, that "*the western limit of the black shale is, roughly speaking, the Essex and Kent county line; and in places in Kent county these shales extend south as far as Lake Erie; although they are missing in Kent over a number of anticlinal folds.*" Thereby establishing two things: First, and incidentally, that the contour of the Antrim or Genesee shales, as figured in the 1903 report of the Michigan Geological Survey, errs by defect, as does also the outline mapped by the Dominion Government Survey, in showing the extent of these shales; and second, (and more to the purpose of the argument in hand to establish the fact of a Silurian anticlinal in the western part of Essex county), that anticlinals have interfered to displace later deposits in this southwestern section of Ontario. A Silurian anticlinal is the solution of the problem offered. For that matter the Lime Kiln Crossing in the immediate neighborhood of the Amherstburg Quarries, in the Detroit River, known to sailormen as the danger spot of the lakes for deep draft boats, is part of a Silurian anticline.

* Well records show a varying depth of these shales at the North side of Kent County from Dresden to Bothwell, of 180 feet, 146 feet, 98 feet, 200 feet, and 77 feet.

SUCKER CREEK OIL AND GAS COMPANY'S TEST WELL, ANDERDON TOWNSHIP, ESSEX COUNTY, ONTARIO. ALT. 609 FT.

CHAS. W. MILLER, CONTRACTOR.—DRILLER'S LOG.



1-60 ft. Blue clay and gravel.

60-150. Gray limestone. Brisk effervescence. (At 72 ft. a strong flow of fresh sulphur water.)

150-410. Brown dolomites. Considerable effervescence at 400 ft.

410-440. Sylvania Sandstone.

440-500. Coarse-grained dolomite.

500-667. Blue dolomite.

667-683. Gypsum. No effervescence at 683.

683-840. Brown dolomites. Remarkably soft to 720. ft. Very m. , harder to 760 ft., and darker to 840 ft. Considerable effervescence at 720 feet, and 840.

840-890. Blue dolomite. Effervescence from 890 feet down slow.

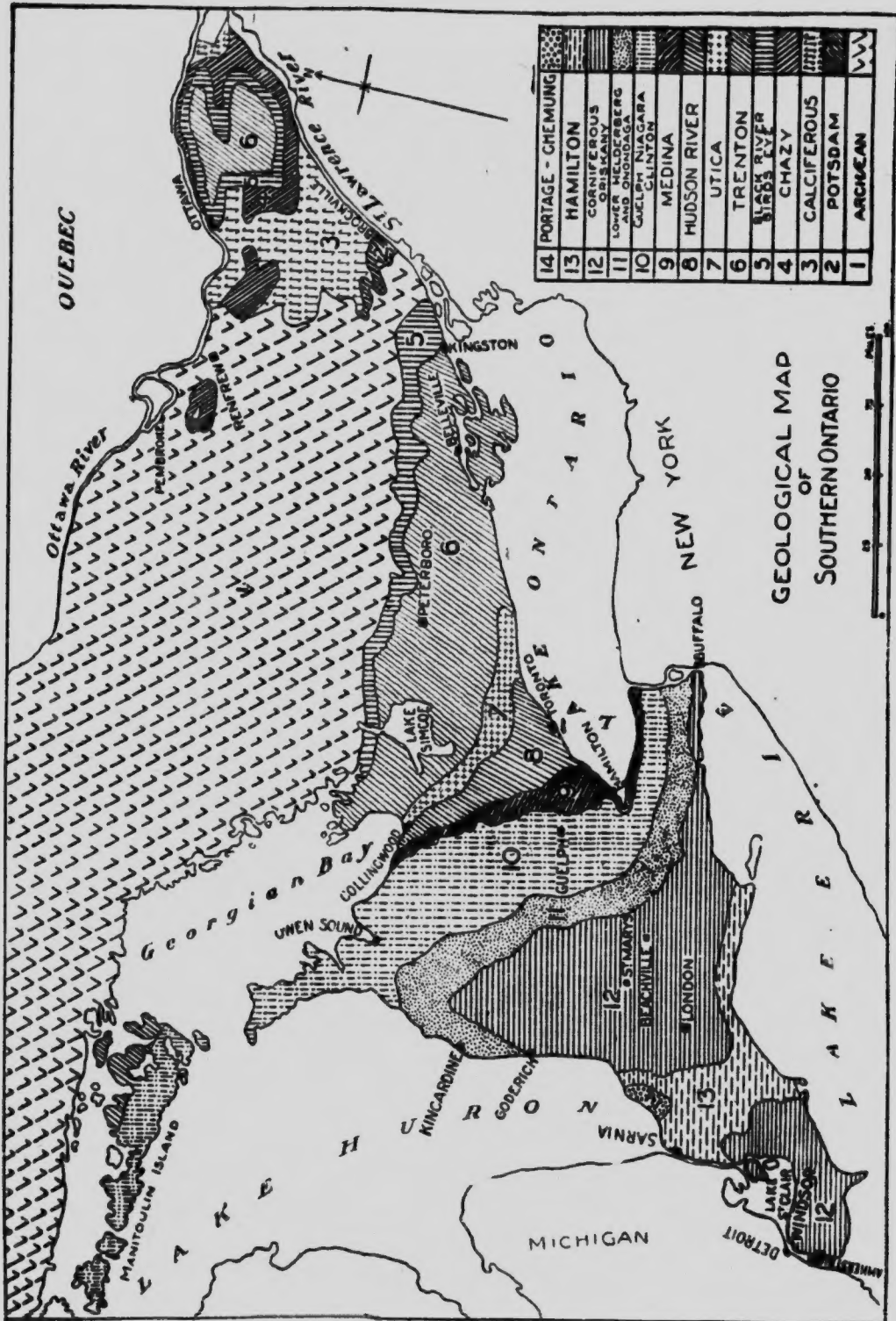
890-950. Light gray dolomite.

950-1125. Brown dolomite; fine; coarse; fine and harder. (A trace of salt sand together with a little salt water at 1075-1080.)

1125-1144. Salt sand and salt water, changing to a brown hard rock.

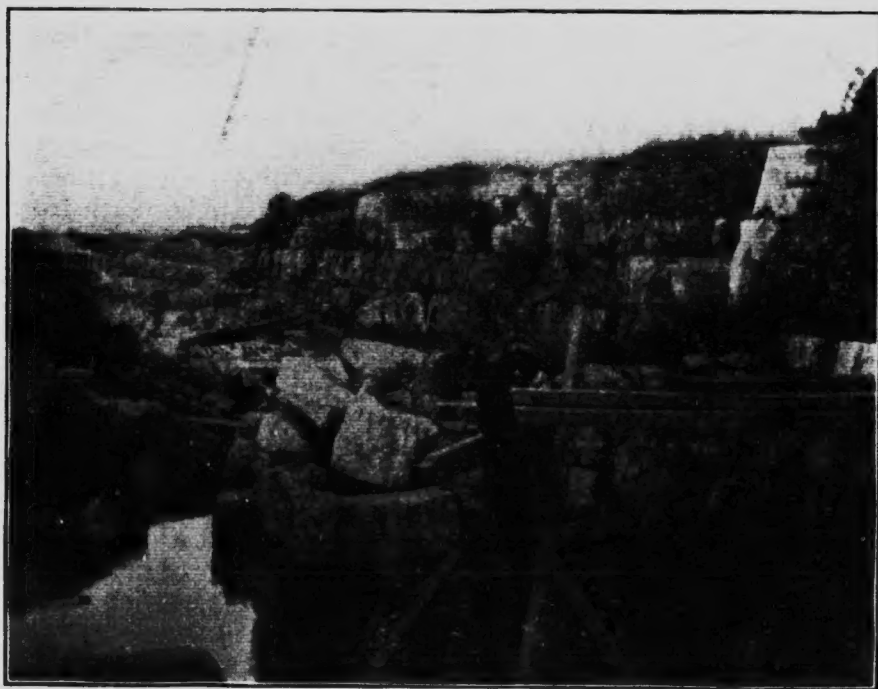


Quarry of gray dolomitic limestone, Anderdon, resting on high grade limestone floor; showing also (upper half of bluff), thin-bedded deposits Essex County.



The Geology of the Western End of Lake Erie does not appear to have been very well worked out by either Michigan, Ohio, or Ontario. It is therefore with some diffidence that I advance an opinion. I am, however, convinced that those forces which gave rise to unconformity between the Silurian and the Devonian strata, caused an expansion of the Devonian sea southward and southeastward. In proof of this let it be stated that the rock outcropping on Pelee Island, and (as I am told) on Middle Island and Kelley's Island, in Lake Erie, is the same as that in the Amherstburg Quarries in Anderdon Township. The approximate limit of deposit of the Devonian westward corresponds, very probably, as nearly as may be, with the international boundary line until it passes North Bass Island, thence curving southward till it passes the west side of Kelley's Island. If this be (as I believe it to be), the delimitation of the Devonian in this direction, it follows that the Corniferous strata rest unconformably upon the earlier deposits of the upper Silurian at the west end of Lake Erie.

The surface extension over the entire upland of Pelee Island is the same thin-bedded limestone as lies over the heavy bedded stone in the Amherstburg Quarries. At the north end of the island the rock has faulted, leaving



Showing the heavy beds from which the block stone was quarried for the Canadian Sault canal locks, and for the old locks at the American Sault. The same quality of stone was taken from Pelee Island to build the locks at Port Colborne, on the Welland canal.

a bluff, with north exposure of the thin and heavy bedded lime. About the middle of the island on the west side, is another similar elevation of 598 feet to 608 feet, or thereabout, breaking off eastward at an angle with the north and south faces of the ridge. But at no place on the Island is there an exposure deep enough to show the high grade limestone that underlies the heavy beds.

The siliceous strata occurring in the Sibley quarry, near Trenton, Wayne

county, to which my attention was directed by Mr. K. J. Sundstrom, General Manager of the quarry, are of a later horizon than the thin-bedded strata in Anderdon and on Pelee Island. It would appear that the depositing of the same limestone beds has gone on for a long period in the Corniferous age, in Wayne county, after it had ceased in Essex county by reason of the elevation of the Devonian sea bottom. There is evidence of disturbing forces at work producing this uplift presented: (1) in the faulted and disturbed condition of the Lake Erie islands; (2) in the irregularly undulating surface of the Silurian rock in Detroit river bed and in Monroe county; and more particularly (3) in the fact of the absence of the later Corniferous beds on the Canadian side of the river which are present and exposed in the Sibley quarry.

It will not be without interest to note the *varying elevation of the Sylvania sandstone* which forms a very considerable surface extension in Monroe county. At Amherstburg, in the bed of the river, opposite the D., B. I. & W. Ferry Company's dock on Bois Blanc Island, it forms a surface extension over a very small area, at an elevation of 552.5 feet. At the Sucker Creek Gas and Oil Company's test well in Anderdon Township it occurs at the elevation of 199 feet. At the Salt Shaft below Detroit the elevation is 155 feet. At Belle River, about half way along the south side of Lake St. Clair, one record shows a sand rock at an elevation of 312 feet. Almost due south of this on Pelee Island, in Lake Erie, the elevation is, approximately, 300 feet to 325 feet.

In five wells put down by the Solvay Process Company, below Detroit, the *Sylvania Sandstone runs from 80 feet to 103 feet in thickness. Contrasted with this there is 84 feet of it in the †Parks Well in Malden Township, some two miles distant from the outcrop in the river bed between Bois Blanc Island and Amherstburg. ‡ The Caldwell grove well a mile north from this shows 60 feet. In the ‡Anderdon well already referred to there is 30 feet. At Belle River, 25 feet. And|| on Pelee Island, 40 feet.

The Depth of Till over the western half of Essex county varies from 60 feet to 110 feet. Mr. Coste, whose name was mentioned in connection with the Genesee shales, says: "The depth of the drift over the east half of Essex and the west half of Kent seems to vary from 90 to 200 feet, being mostly from 100 to 150. Its character varies a great deal but it most often consists of about 100 feet of boulder clay, and from 20 to 30 feet of sand or gravel under that." At Bothwell, at the northeast corner of Kent county, where the surface ‡elevation is 691 feet, there is a maximum depth of till, 255 feet.

The Point of Highest Elevation in Essex county is at Ruthven, on the old Talbot road, west of Leamington. Here there is a deposit of sand and gravel and boulders, of the Belmore Beach doubtless, with an elevation of 734 feet, the western limit of a ridge of the same material that extends parallel with Lake Erie almost its entire length, and which reaches a maximum elevation, for the two counties, of 736 feet near the southeast corner of Kent.

St. Andrew's Manse, Amherstburg, Ontario, March 8, 1907.

* My Report on the Corniferous Exposure in Anderdon, Bureau of Mines, Ontario, 1902, page 123.

† Brummell's report on Natural Gas and Petroleum in Ontario, 1892, Geological Survey of Canada.

‡ Log of Sucker Creek Gas and Oil Company's well, Chas. W. Miller, drill contractor, 1905.

|| Drillings examined by Dr. H. M. Ami, Ottawa, 1896.

§ Surface elevations quoted are as given in the Dictionary of Altitudes in Canada, by James White, F. R. G. S., Geographer to the Dominion Government Geological Survey. The rock elevations are from individual well records, except in the case of the Amherstburg Quarries and the Detroit River bed. These latter were ascertained by Mr. Charles Y. Dixon, of the U. S. War Department Office, Detroit.